

# Portland Harbor Pre-Call/Background

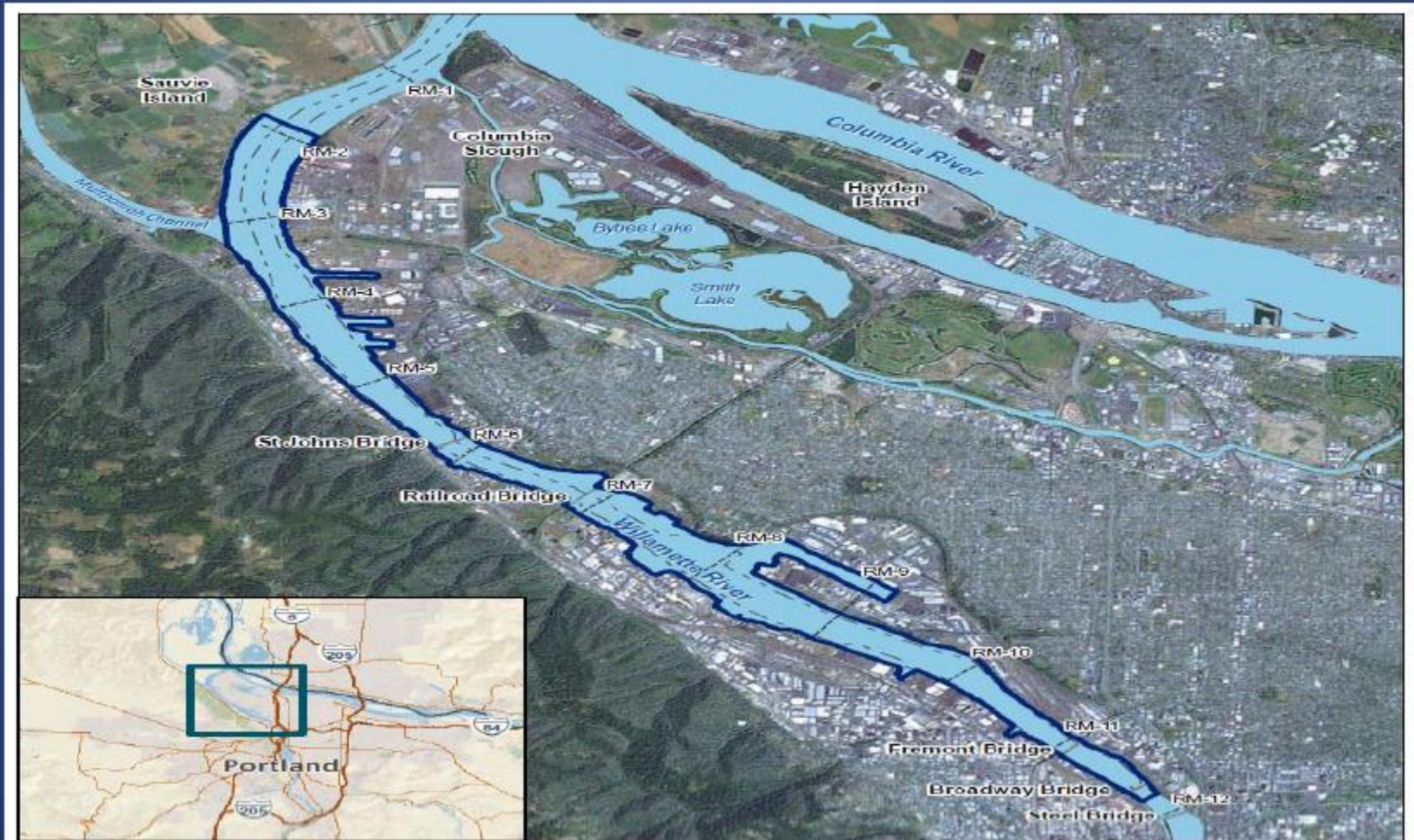
Presentation to the  
CSTAG/NRRB  
October 27, 2015

Kristine Koch, U.S. EPA Region 10

# Portland Harbor

## Background Information

# Portland Harbor Superfund Site



# Conceptual Site Model

- Big Site
  - 10 River Miles
  - 2,190 acres
  - Industrial land use
  - Authorized Navigation Channel
  - Below Downtown Reach – DEQ lead



# Conceptual Site Model, cont.

- Complex
  - Over 90 COCs
  - 150 PRPs
  - Multiple sources
  - Large variation in hydrodynamics and grain size
  - Multi-media
    - Sediment contamination
    - Groundwater contamination
    - Surface water contamination

# Conceptual Site Model, cont.

- High risks
  - Greatest risk from consumption of resident fish
  - Harbor-wide: PCBs are the primary contributor to risk from fish consumption
  - River Mile Scale: Dioxins/furans are a secondary contributor risk and hazard
  - Non-cancer risks are driver for cleanup
  - PCBs, DDx, dioxin and PAHs are most ecologically significant
  - Benthic Community – toxicity, TBT, metals, PAHs, PCBs, pesticides, cyanide and BEHP

# Portland Harbor

## Remedial Action Levels vs. PRGs

# RALs vs. PRGs

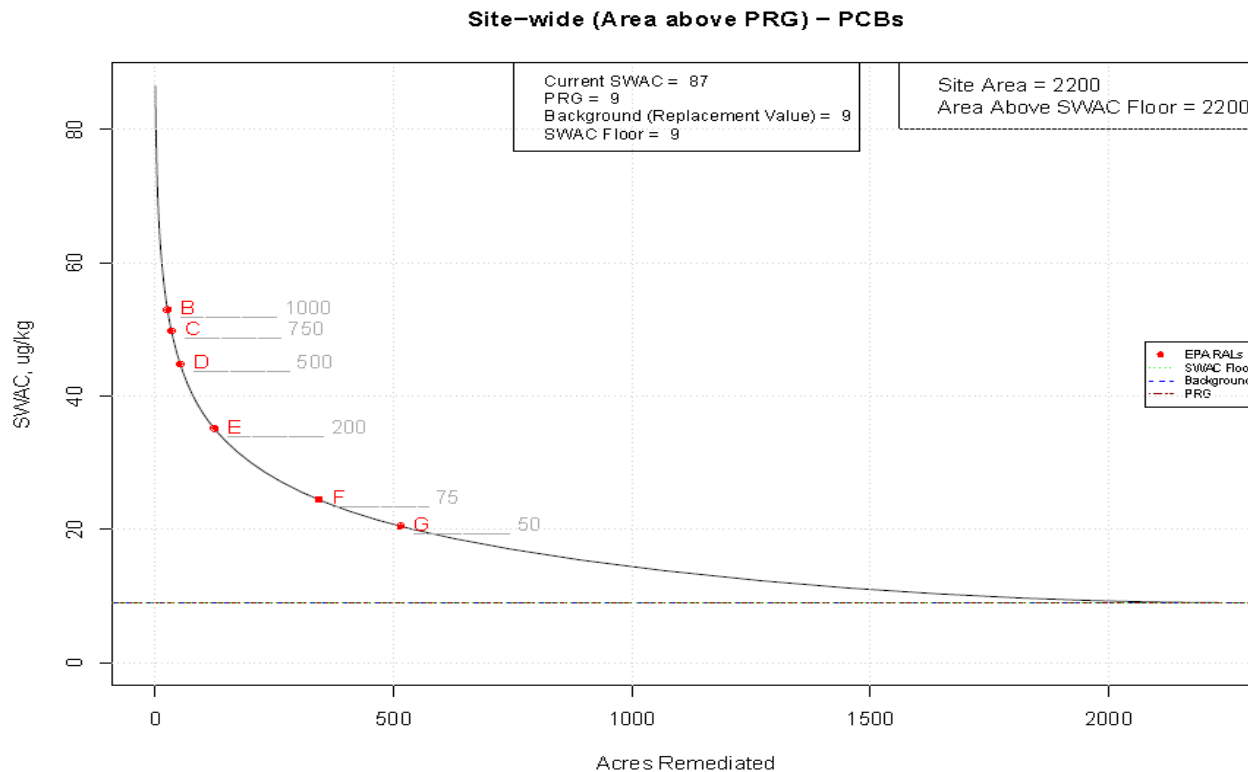
- Entire site (2,190 acres) exceeds PRGs
- Allows for range of alternatives in FS
  - Less action to more action
  - Identify sediment management areas – capping/dredging
- Levels of Active Risk Reduction
  - Maximum incremental reduction
  - Point of minimum concentration change
- MNR/EMNR to achieve RG
- Background considered



# Focused COCs

- Subset of COCs with most widespread footprint
  - PCBs
  - PAHs
  - Dioxins/furans
    - PeCDD
    - PeCDF
    - TCDD
  - DD<sub>x</sub>

# Example RAL Curve



**Figure 3.3-1**  
**PCBs Site-wide RAL Curves**

# Remedial Action Levels

Contaminant	B	C	D	E	F	G
PCBs	1,000	750	500	200	75	50
Total PAHs*	170,000	130,000	69,000	35,000	13,000	5,400
1,2,3,7,8-PeCDD	1	1	1	0.2	0.2	0.009
2,3,4,7,8-PeCDF	0.003	0.002	0.0008	0.0008	0.0008	0.0008
2,3,7,8-TCDD	0.002	0.002	0.002	0.0006	0.0006	0.0006
DDx	650	550	450	300	160	40

\*Equivalent to cPAH RALs in draft FS.

All units µg/kg.

# Portland Harbor

## Assignment of Technologies

# Technology Assignment

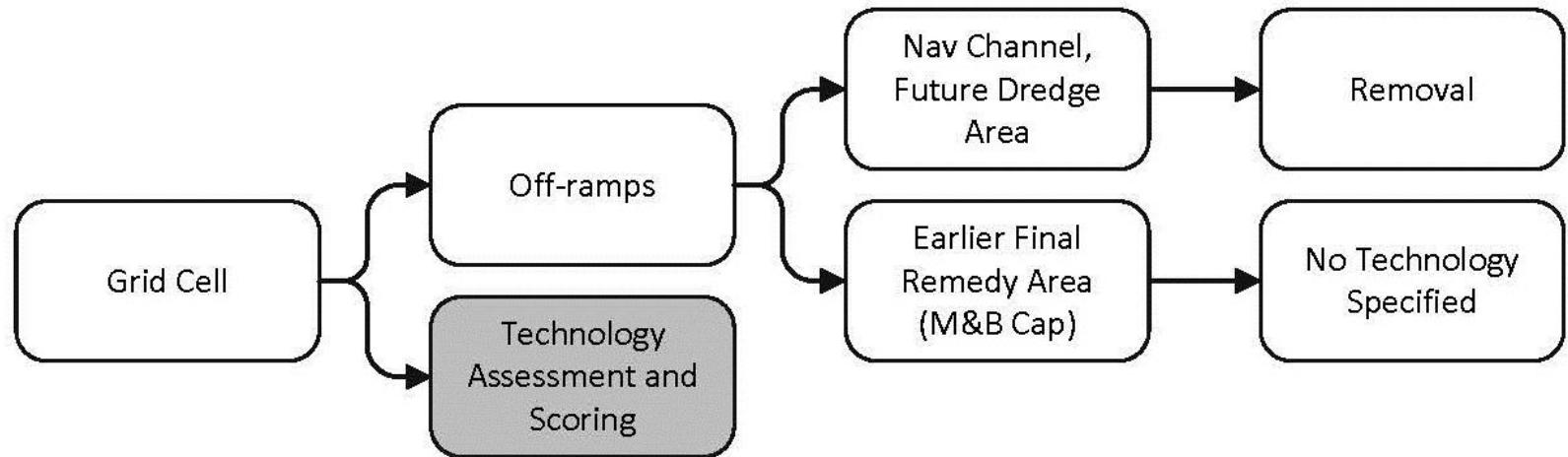
**Objective:** Develop a process that evaluates remedies based on environmental conditions:

- hydrodynamics, sediment bed characteristics, and anthropogenic conditions
- Uses a decision tree / multi-criteria decision approach to indicate an appropriate technology:
- EMNR/in-situ treatment
- Cap – engineered cap with/without active component
- Dredging

**Outcome:** Process indicates appropriate technology based on analysis... **It does not select a remedy.**



# Overview of Technology Assignment Process



# Technology Assignment Matrix

## Criteria Scoring

- +1 = technology favorable
- 0 = technology neutral
- -1 = technology unfavorable
- NC = not applicable

Technology Assessment Scoring		Dredge	Armor Cap	Cap
Hydrodynamics	Wind/Wave Zone?	1	0	NC
	Erosive?			-1
	Depositional? (<2.5cm/year or Subsurface:Surface Ratio>2)?	-1	1	1
	Shallow?	1	-1	0
Sediment Bed Characteristics	Slope 15-30%?	1	1	NC
	Slope >30%		0	
	Rock, Cobble, Bedrock Present?	-1	1	1
Anthropogenic Influences	Structures/Pilings?	-1	1	1
	Prop Wash Zone?	1	0	NC
	Moderate or Heavy Debris?	-1	0	1
Technology Score		Sum Scores for Each Technology		

# Hydrodynamics Criteria

## Erosive OR Wind/Wave Zone

- Erosive = shear stress exceeds critical shear stress for 2 year recurrence (flood) event – sediment texture as modeled by LWG
- Wind/wave zone – near shore areas – layer provided by LWG as part of FS GIS data

## Depositional

- Either depositional ( $> 2.5\text{cm/yr}$ ) May 2003 to 2009 Surveys (same period LWG preferred for model calibration)

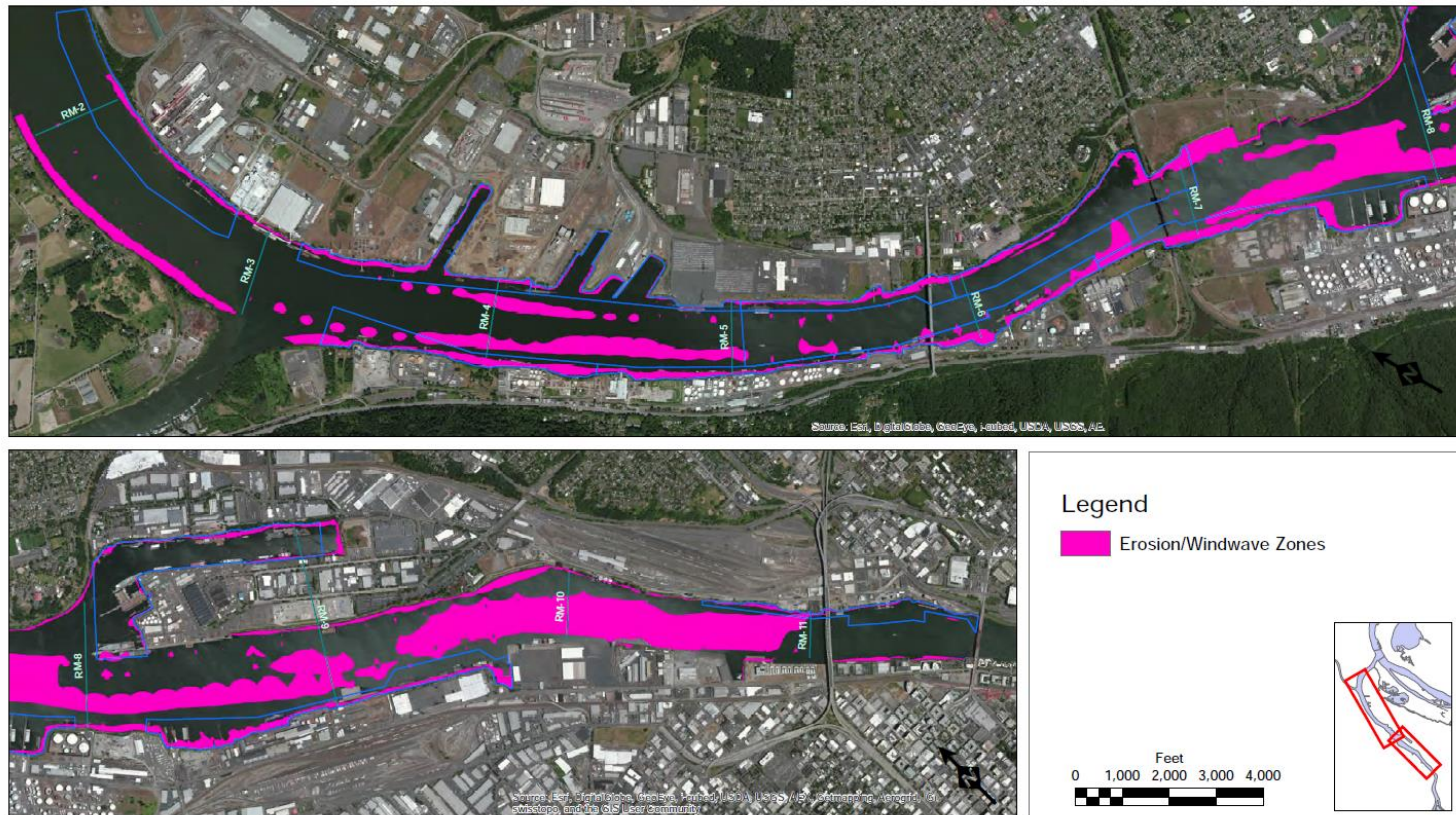
OR

- Average Subsurface/Surface RAL concentrations  $> 2$ 
  - Interpolate 4 RAL COCs – surface vs. subsurface
  - Surface or subsurface must exceed RAL G
  - Average of remaining RAL ratios

## Shallow

- Shallow -  $<1\text{ m}$  at low water level,  $>2\text{ feet NAVD 88}$

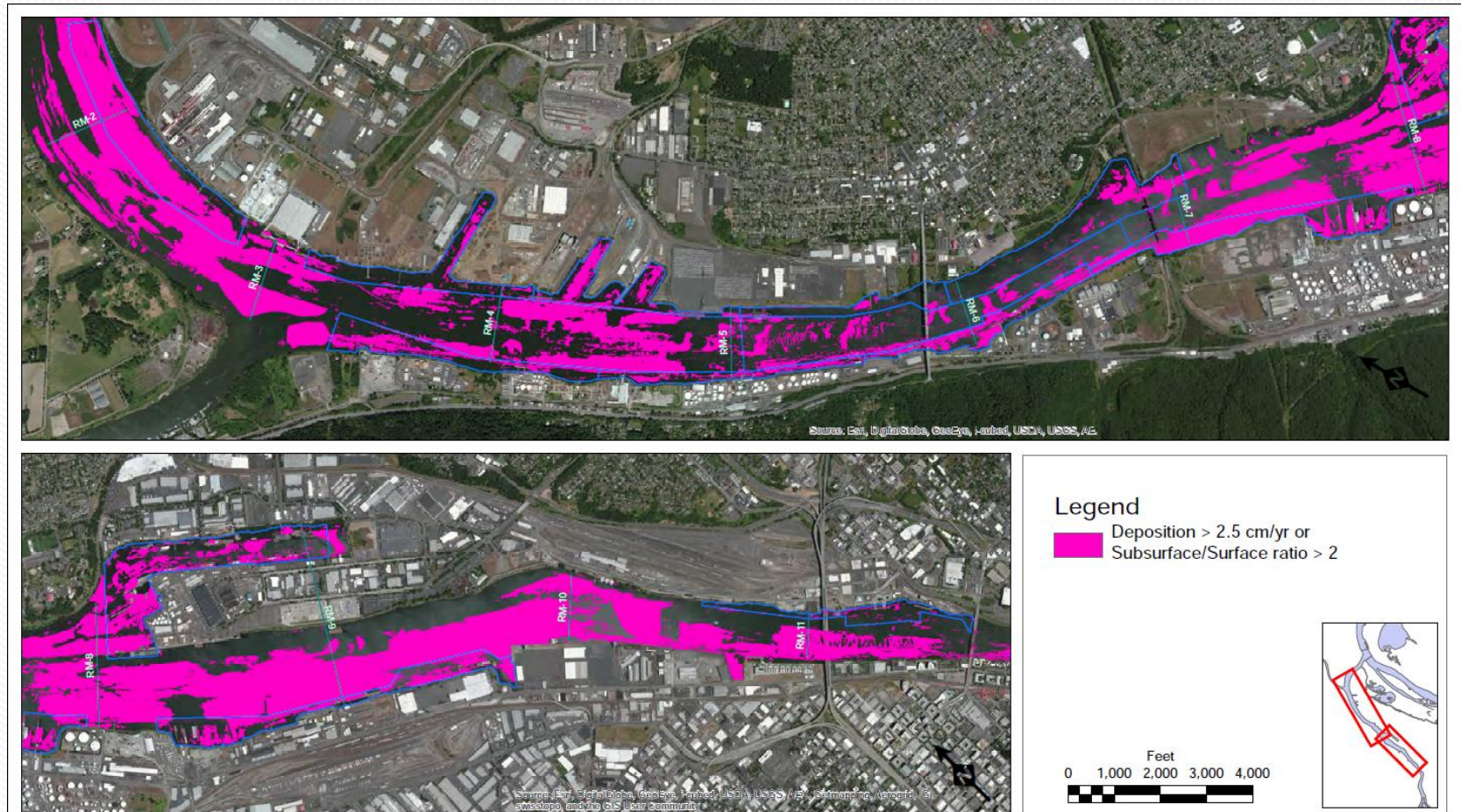
# Wind/Wave Zone



Erosion/Windwave Zones



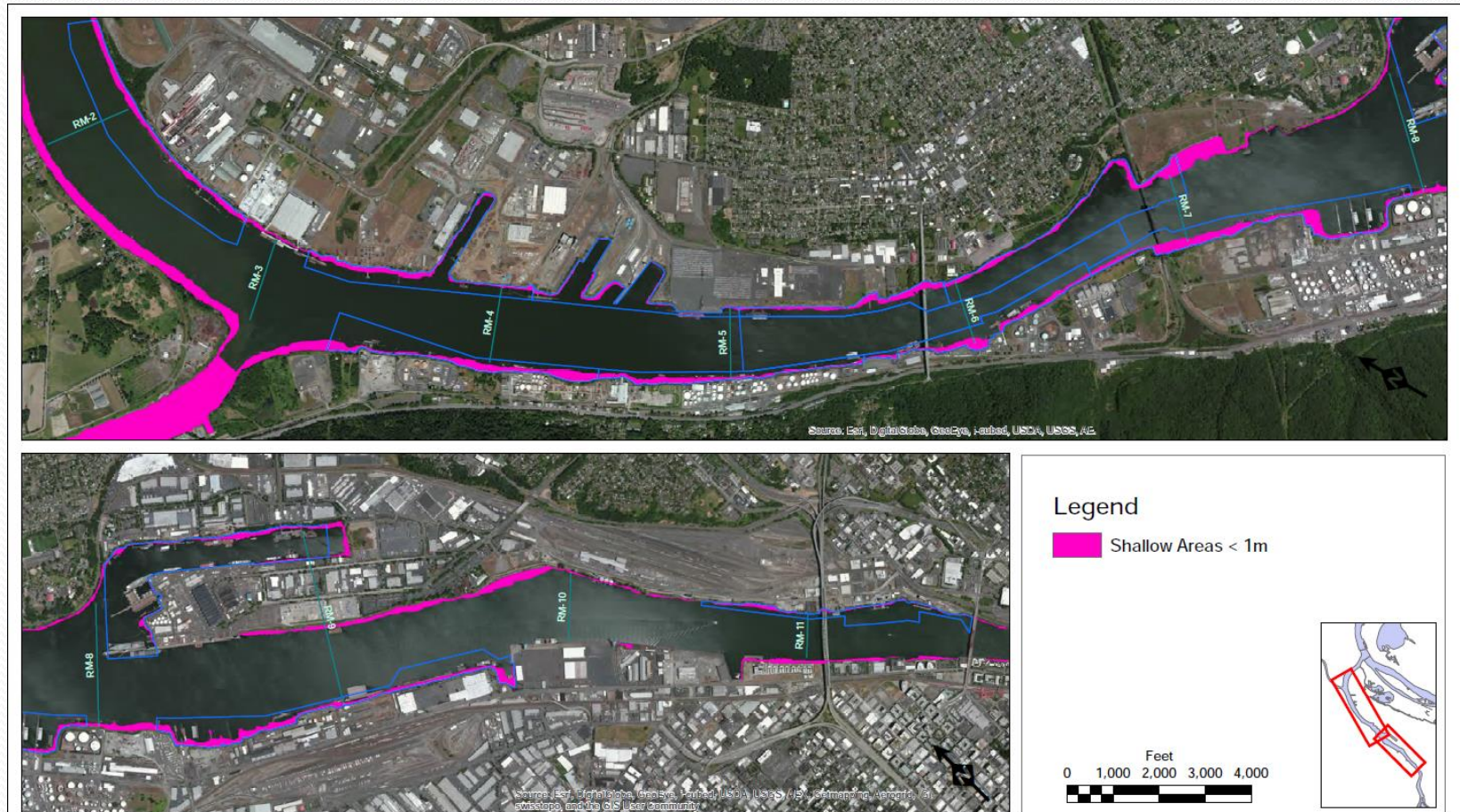
# Depositional



Depositional Areas  
Draft, Deliberative, Do not cite or quote



# Shallow Areas



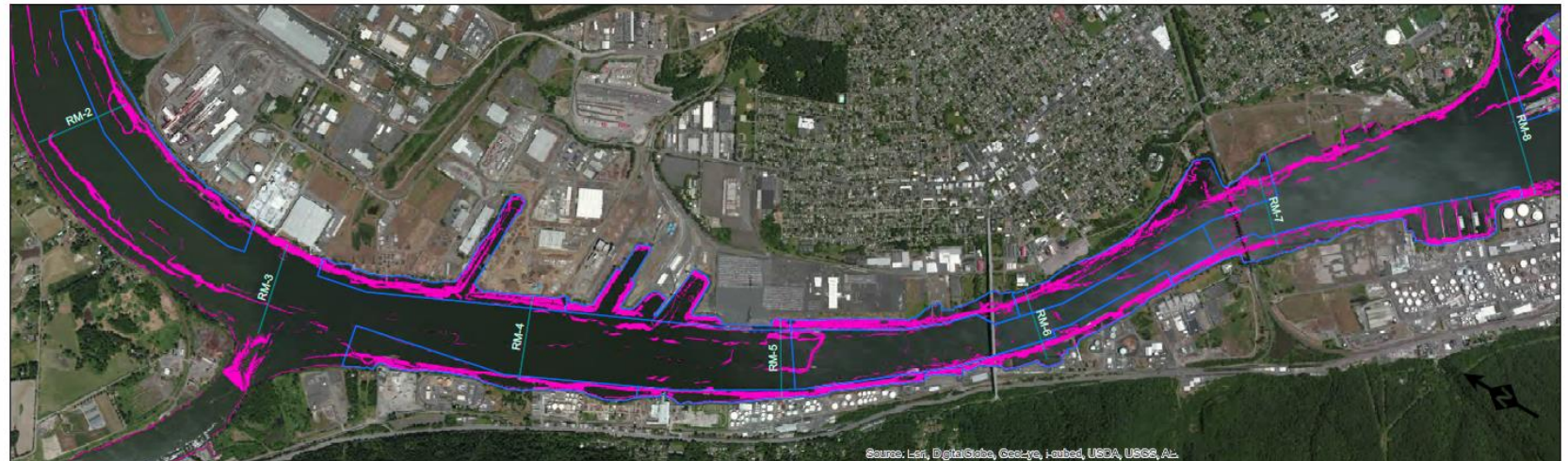
Shallow Areas  
Draft, Deliberative, Do not cite or quote

# Sediment Bed Characteristics Criteria

- Slope > 15 % (Based on LWG 2009 Bathymetry)
- Rock, Cobble, Bedrock within potential dredge prism
  - none identified by LWG after EPA request



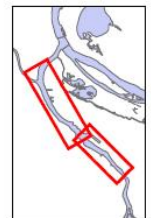
# Bathymetry/Slope



## Legend

Bathymetric  
Slope > 15%

Feet  
0 1,000 2,000 3,000 4,000

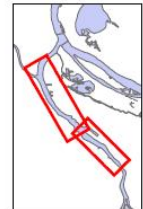
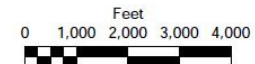
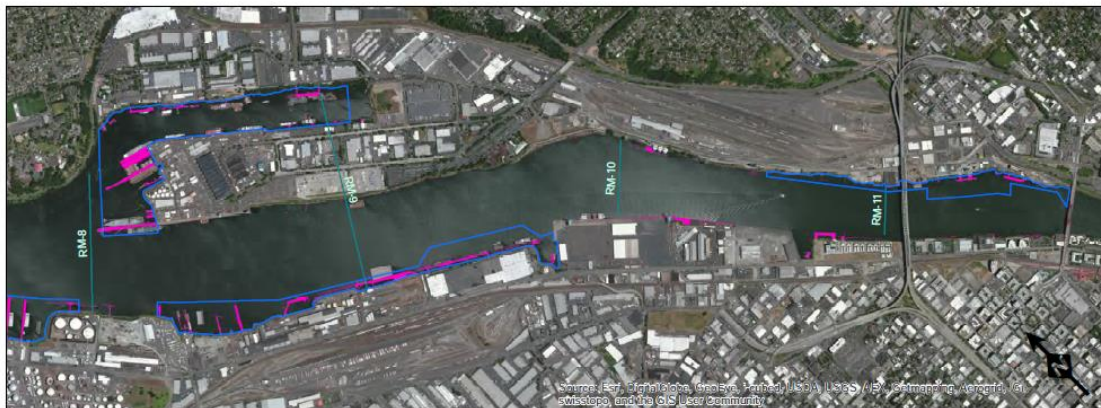
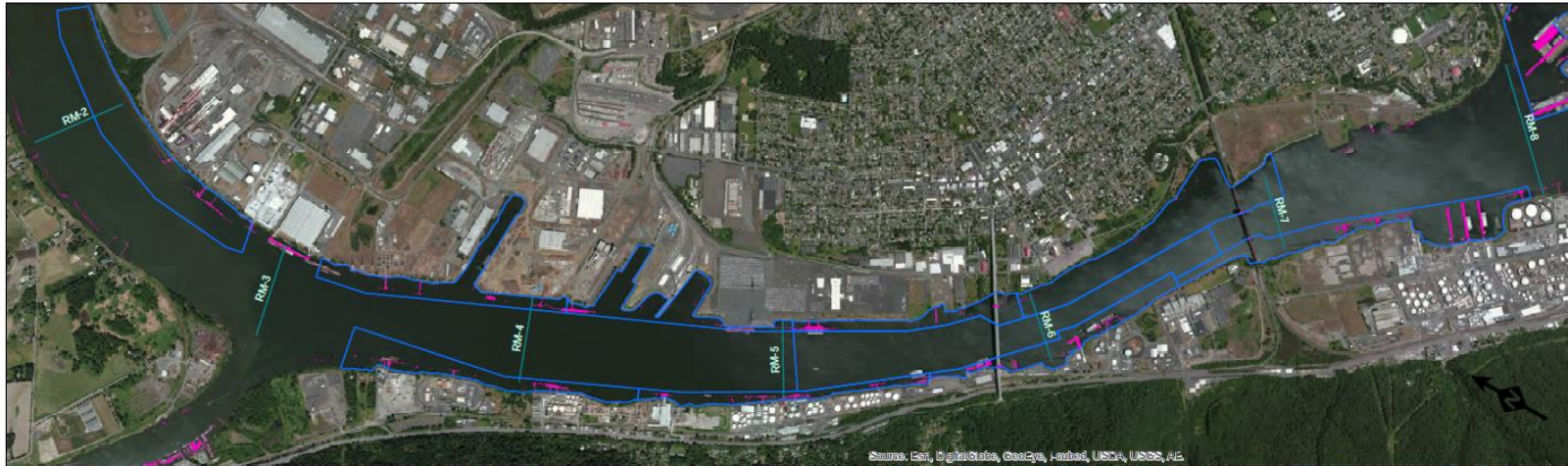


# Anthropogenic Influences Criteria

- Structures and Pilings (LWG provided + pilings and dolphins from debris layer)
- Prop Wash Zone – (LWG provided)
- Debris as indicated by side/scan sonar (LWG provided)



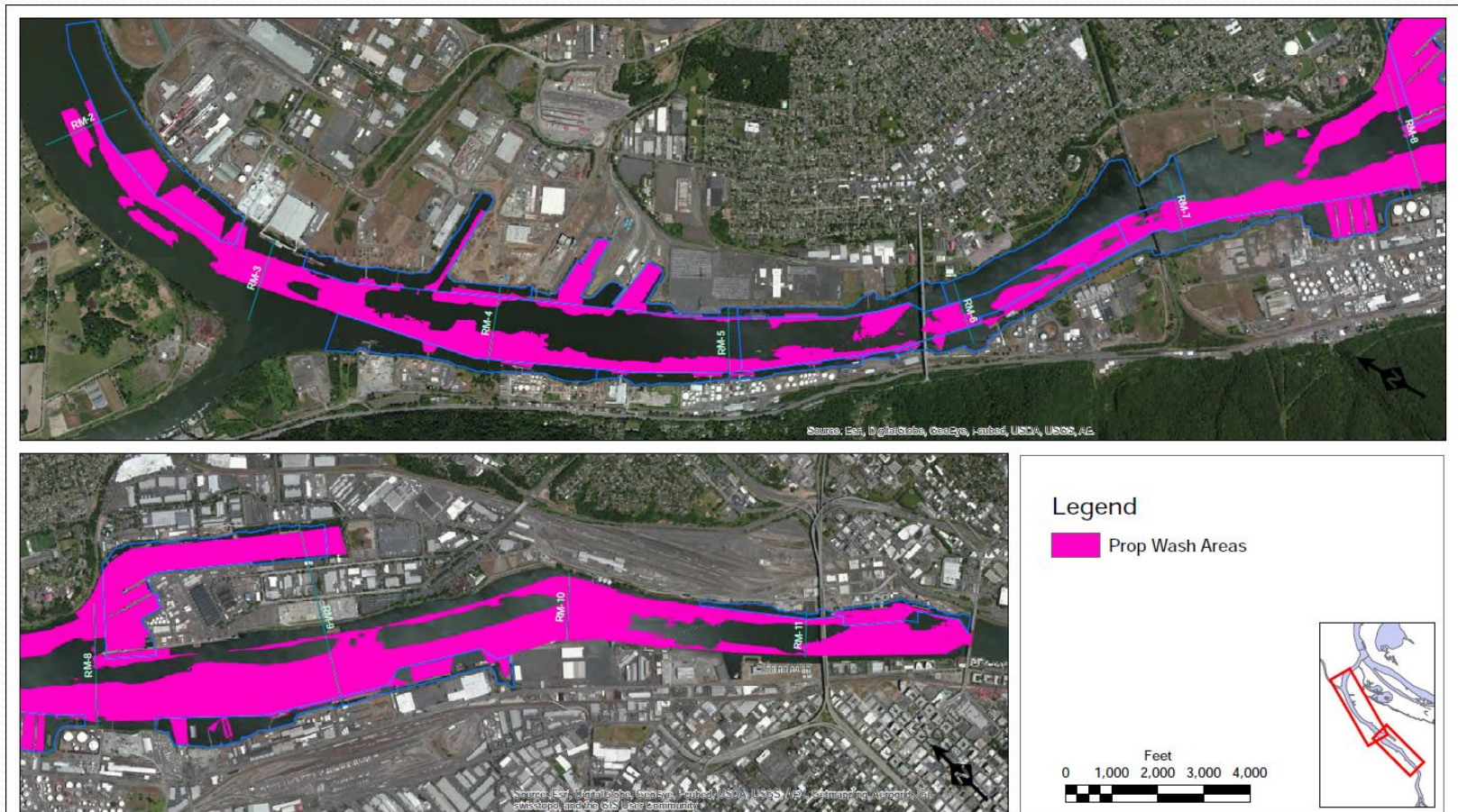
# Structures and Piling



Docks, Structures and Pilings  
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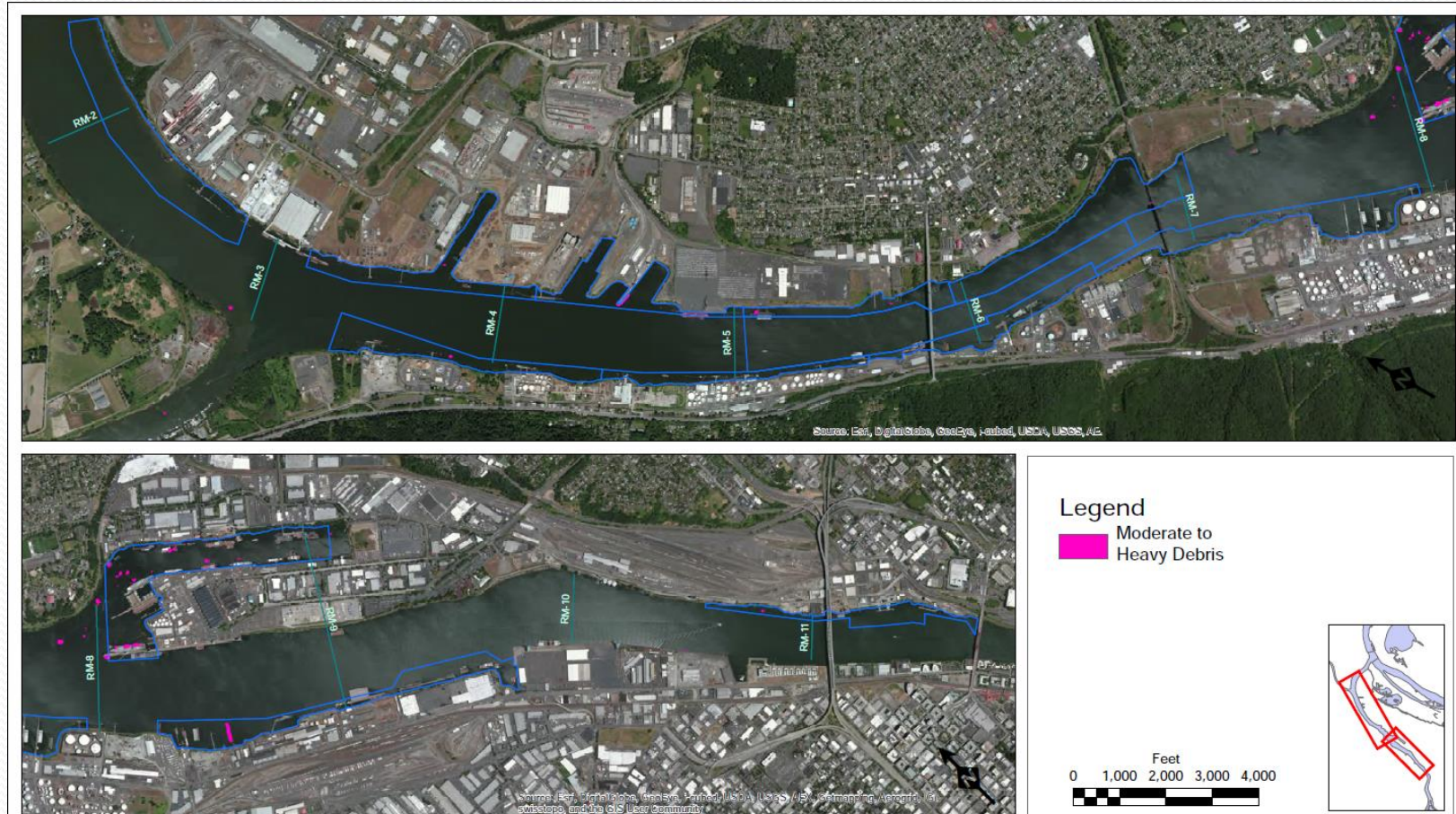
# Prop Wash Areas



Prop Wash Areas  
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# Debris

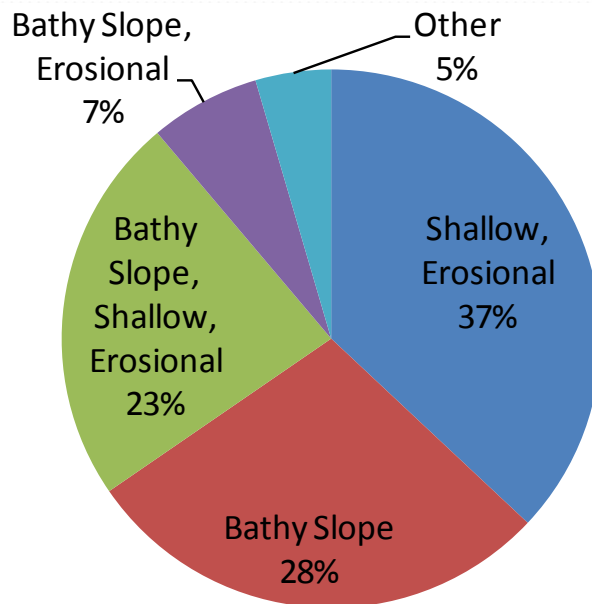


Debris

Draft, Deliberative, Do not cite or quote

# Conclusions

- In areas outside “off-ramps”, dredging was selected due to these criteria:



- Primary drivers were: erosional, bathy slope, and shallow.
- Generally, multiple LoEs; single LoE in 32% of areas.

# Portland Harbor

## Site Areas

# Site Areas

- Based on receptors
- Account for receptor mobility
- Focus on high concentration areas
- Delineate areas of capping/dredging



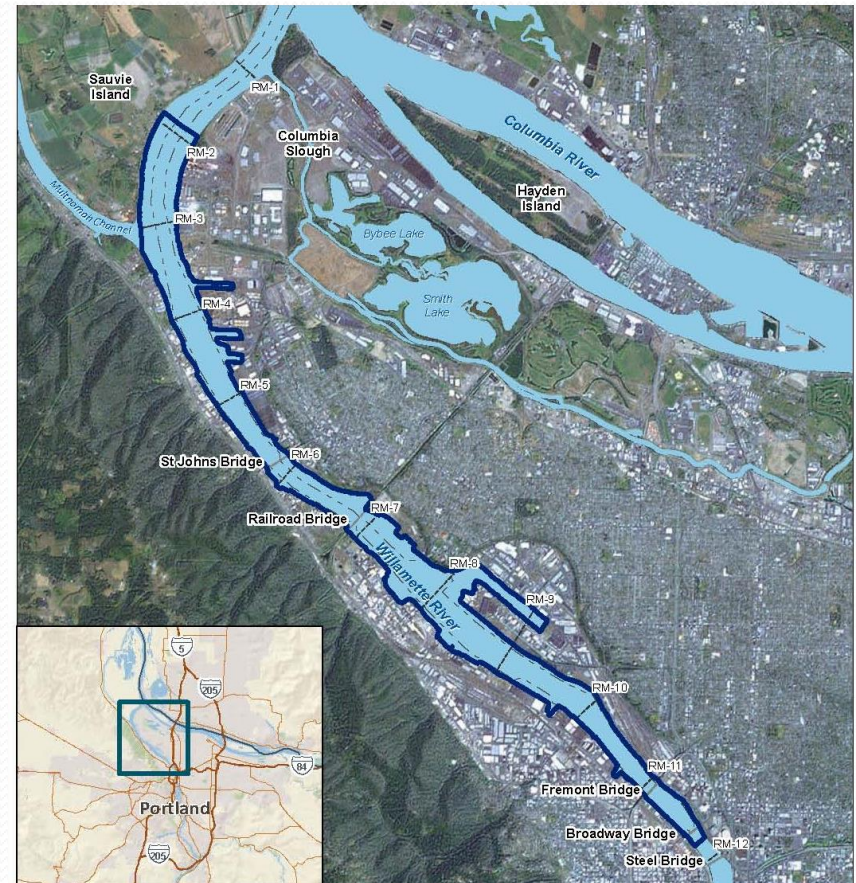
# Site-wide

## Example Receptors

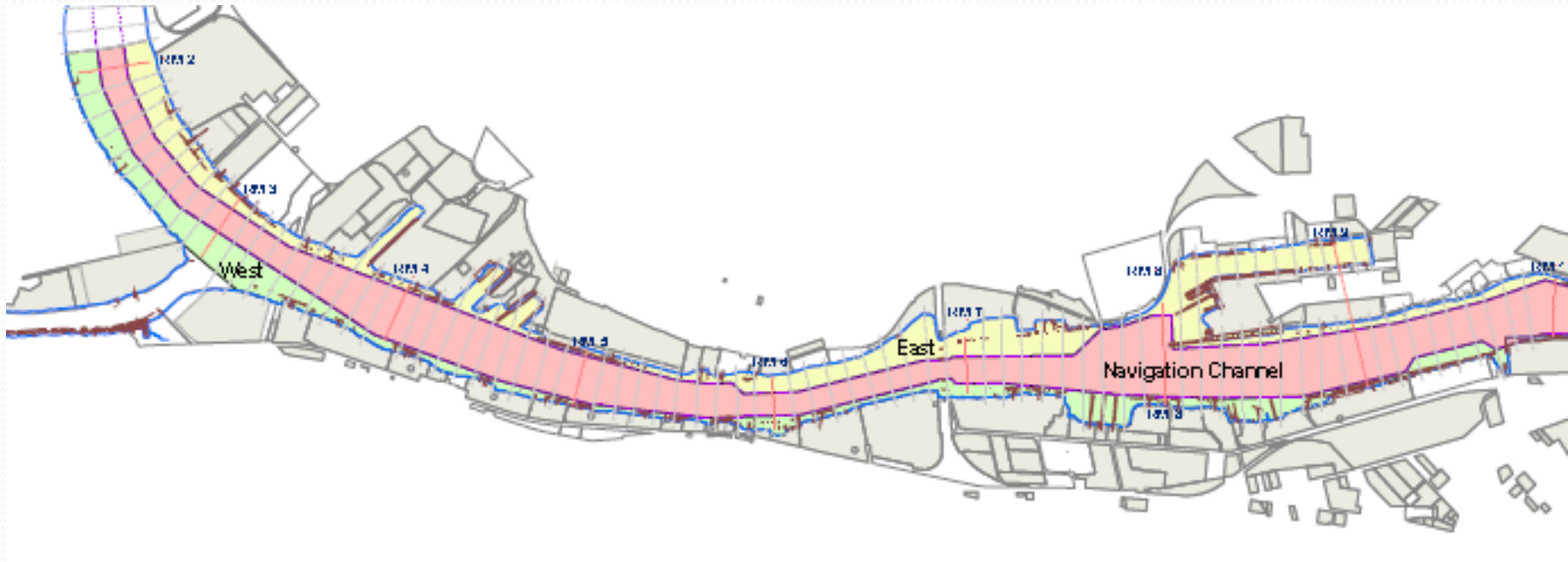
- Subsistence & Tribal Fishers
- Large-home range Fish
- Bald Eagle

## Size

- ~10 RM
- 2,190 Acres



# River Zones



- East Nearshore Zone
- West Nearshore Zone
- Navigation Channel
- Swan Island Lagoon

# 0.1 to 0.2 River Mile

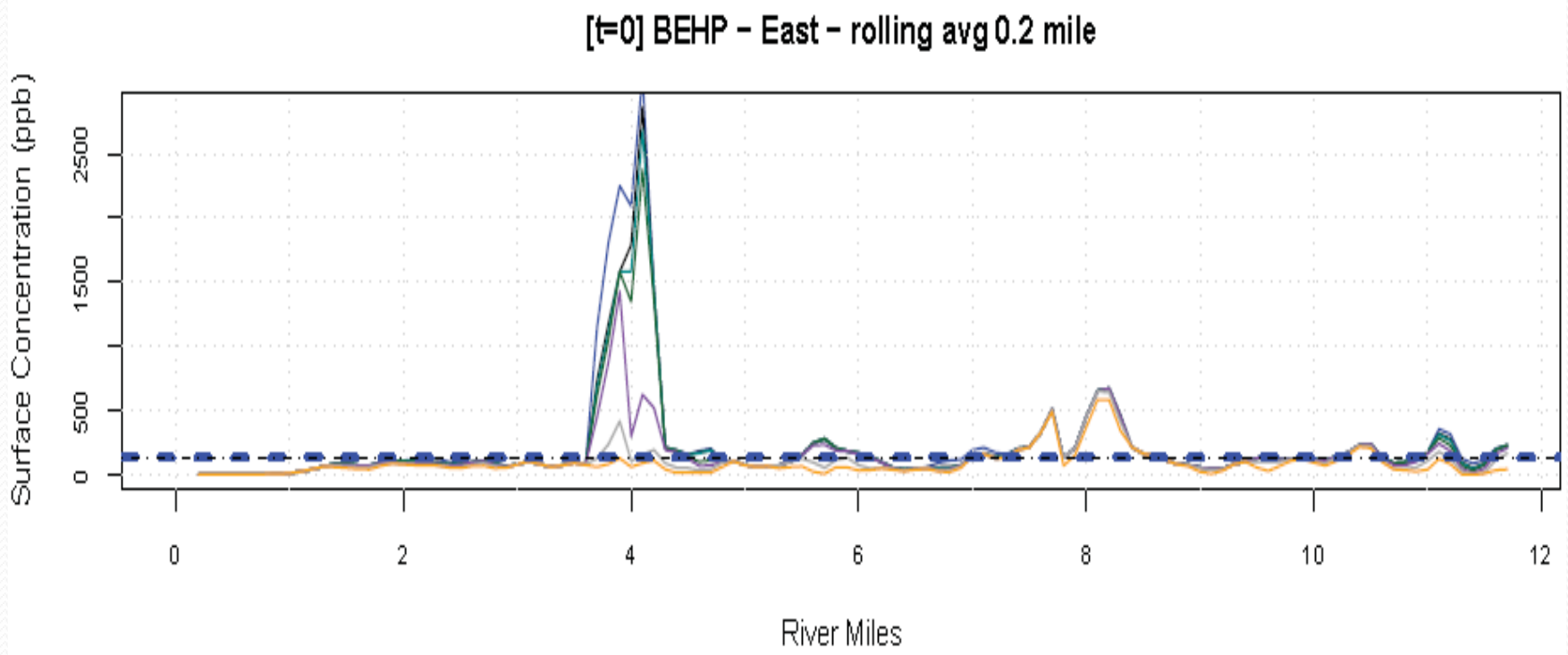
## Receptors

- Sculpin
- Crayfish
- Benthic

## Size

- Rolling 0.2 RM in River Zones

# Example Rolling 0.2 RM



# 0.5 River Mile

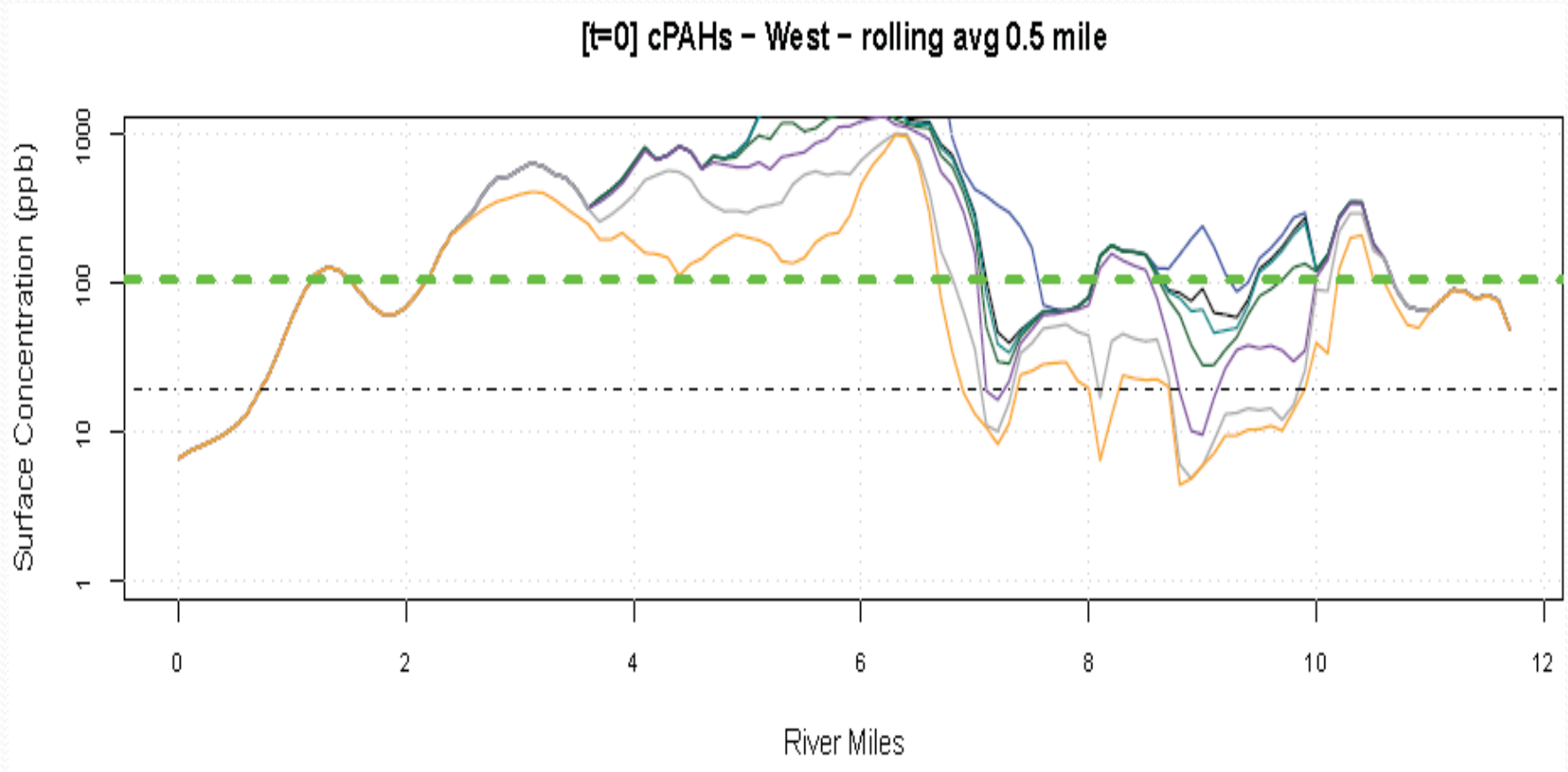
## Receptors

- Human Direct Contact (nearshore only)

## Size

- Rolling  $\frac{1}{2}$  RM in River Zones

# Example Rolling 0.5 RM



# 1 River Mile

## Receptors

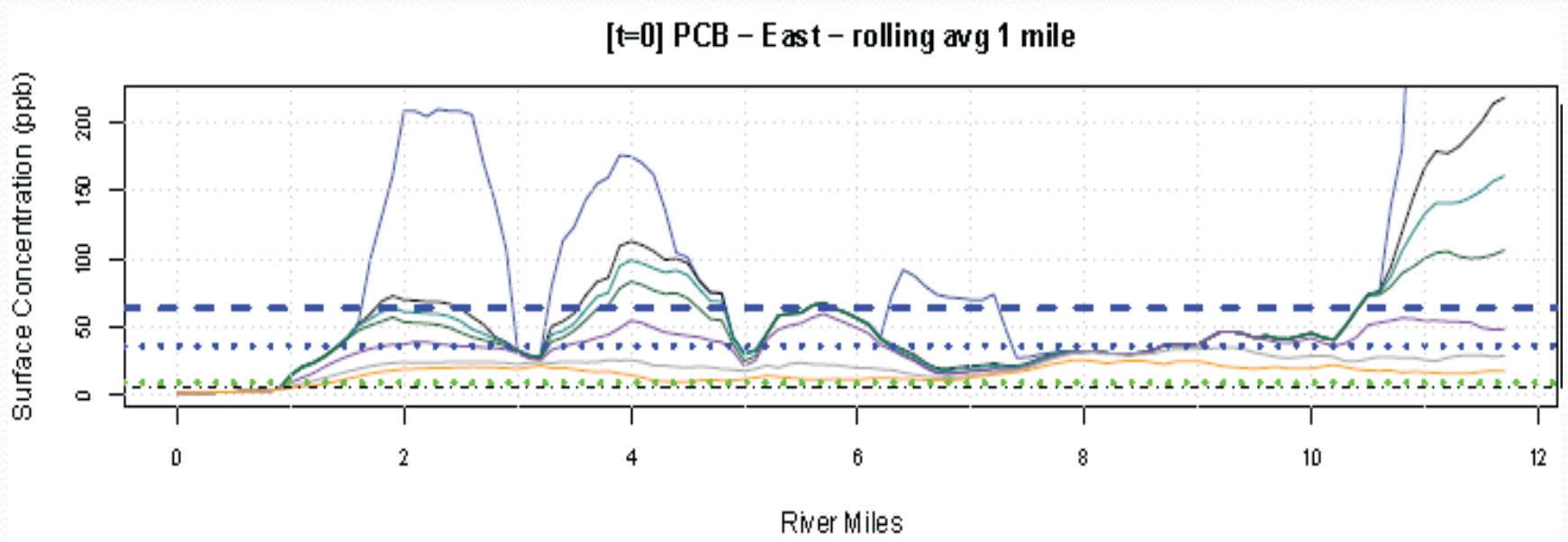
- Recreational Fishers
- Smallmouth Bass
- Mink
- Osprey

## Size

- Rolling RM in River Zones
- SDUs



# Example Rolling 1 RM



# Sediment Decision Units

**Develop a spatial basis for evaluating remediation**

- River Zones
- Centered on contaminant high concentration areas

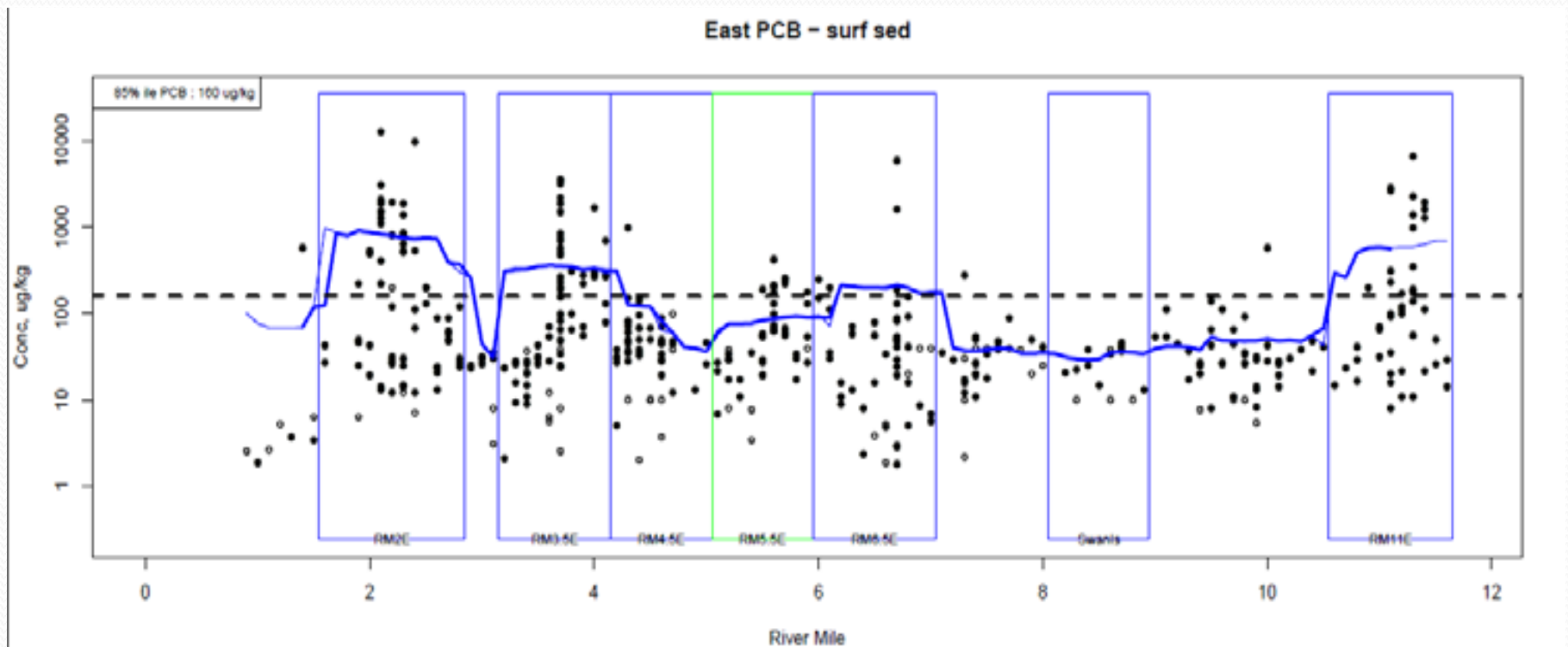
## **Goal**

- Reproducibly defined, spatially based decision area
- Evaluate highest risk reduction

# SDU Approach

- Delineate areas of the site exhibiting the highest concentrations
- Segregate data based on river region
- Develop a rolling average based on non-weighted surface sediment results for the focused COCs
- Adjust SDU boundaries based on interpolated concentration contours
- Circle back to add additional SDUs based on other considerations (e.g., benthic risk, other COCs)

# Example Rolling RM

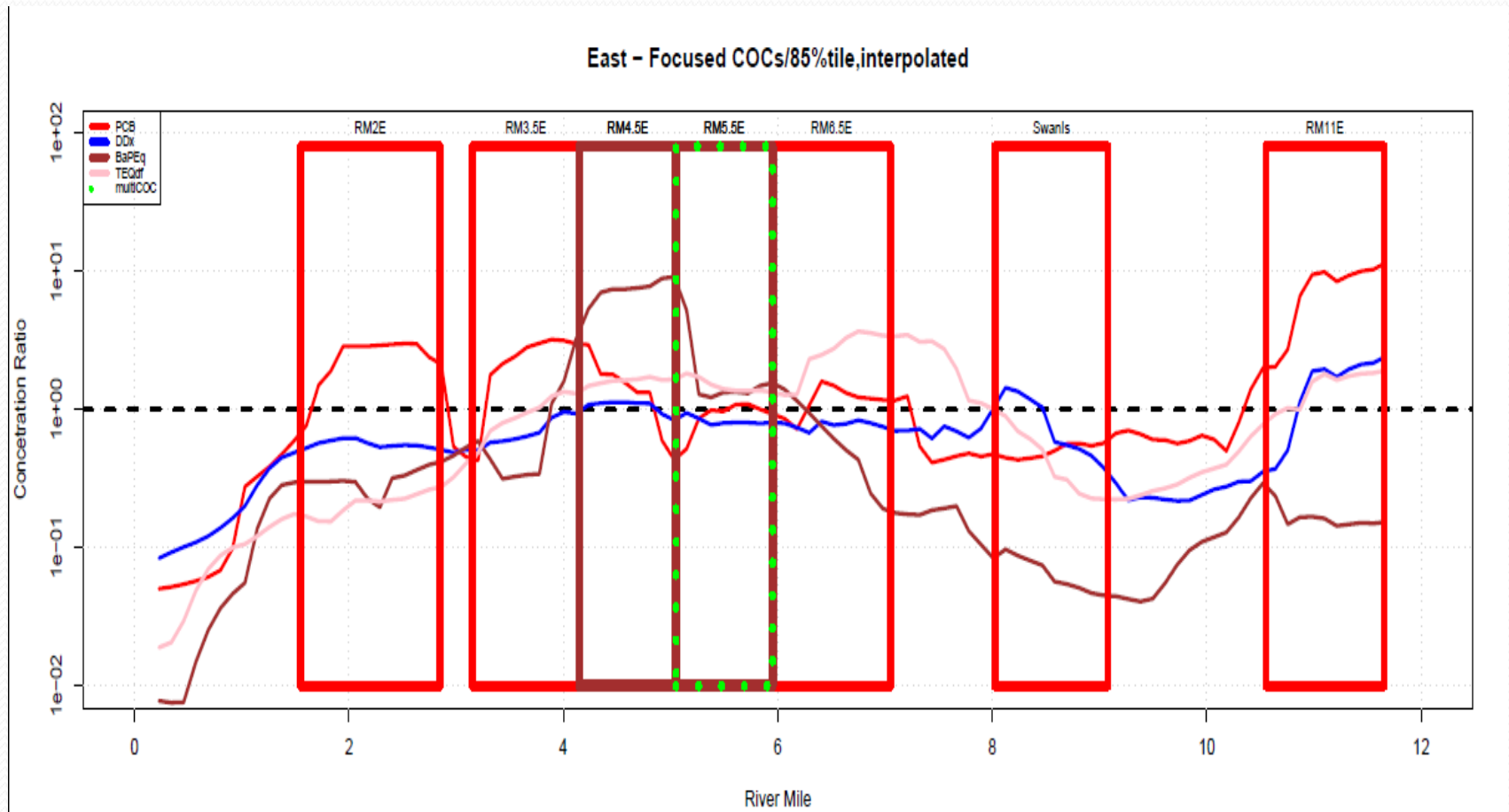


Note: All SDUs shown, not just PCB related ones

Draft, Deliberative, Do not cite or quote



# Example 85% Normalization



# Resulting SDU Evaluation Areas

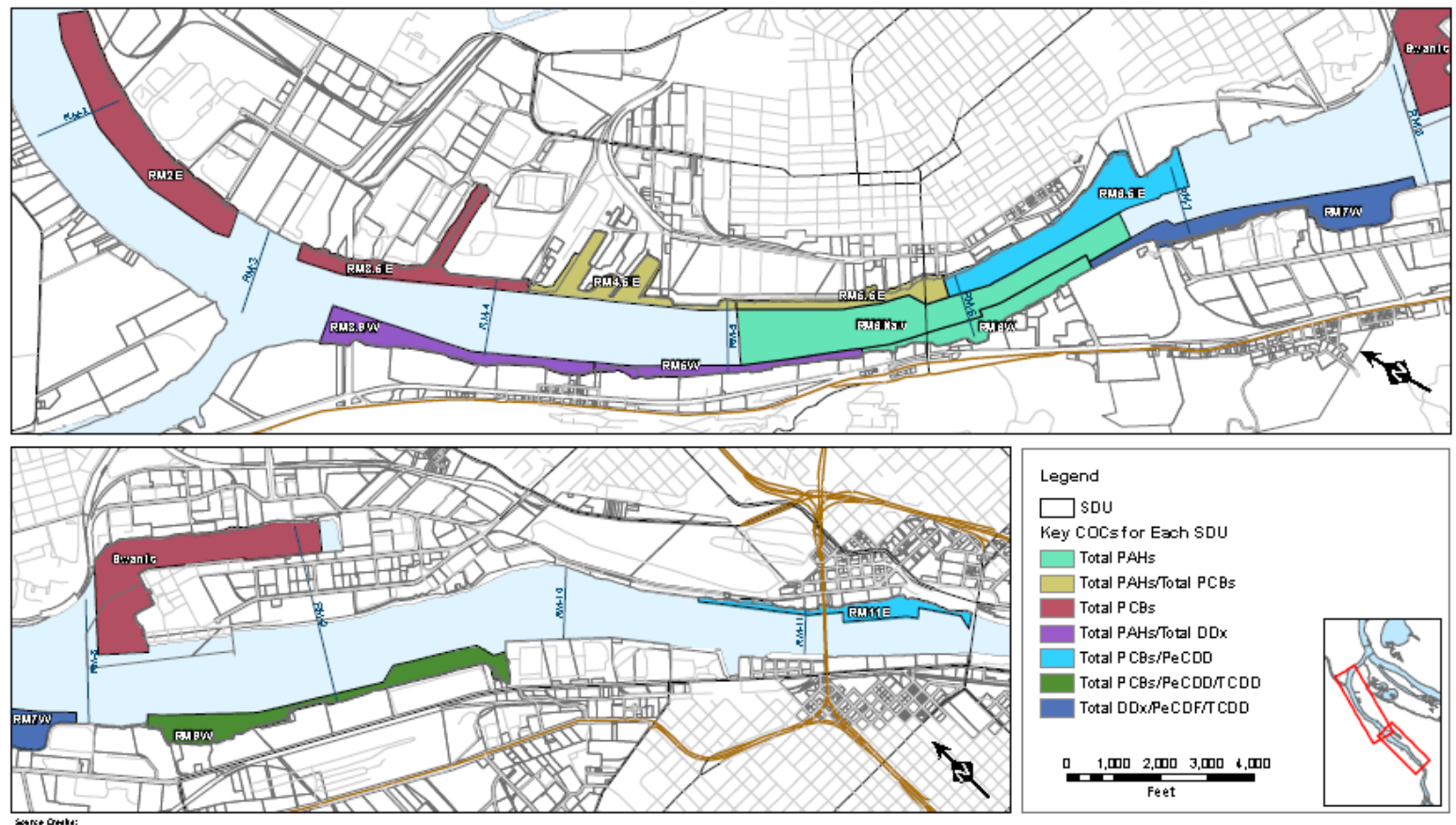


Figure 4.1-2. Sediment Decision Units and Key COCs  
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# Sediment Management Areas

- Dredging/capping technology applied
- Developed from technology assignments
- Delineated by high concentration contours
  - Remedial Action Levels

# Portland Harbor

## Cost



# Major Point of Contention

- PRPs do not want costs underestimated for allocation
- PRPs want cost low
- Mitigation...cost too high
  - 14% capital costs – alt B
  - 58 acres – alt B
- Subtitle C
  - 45% capital costs – alt B
- Dredging unit costs (from LWG 2012)
  - \$38.03/cy – open water
  - \$53.66/cy - confined

# Portland Harbor

## Principal Threat Waste

# Principal Threat Waste

- Source Material - NAPL
  - Chlorobenzene - Arkema
  - PAHs - Gasco
- Highly Toxic – exceeds  $10^{-3}$ 
  - PCBs > 200 µg/kg
  - cPAHs > 100,000 µg/kg
  - DDx > 7000 µg/kg
  - 2,3,7,8-TCDD > 0.02 µg/kg
  - 2,3,7,8-TCDF > 4 µg/kg
  - 1,2,3,7,8-PeCDD > 0.01 µg/kg
  - 2,3,4,7,8-PeCDF > 0.4 µg/kg
  - 1,2,3,4,6,7,8-HxCDF > 0.3 µg/kg

# PTW – Reliably Contained

Contaminant	PTW Contaminants Reliably Contained
Dioxins/Furans	Can be reliably contained
PAHs	Can be reliably contained
Chlorobenzene	<320 µg/kg
DDx	Can be reliably contained
Naphthalene	<140,000 µg/kg
PCBs	Can be reliably contained



# Ex-situ Treatment Assumptions

- NAPL & PTW Not Reliably Contained
  - Chlorobenzene
  - Napthalene
  - PAHs - NAPL
  - DDx mixed with chlorobenzene
- Treatment Method
  - Thermal Desorption

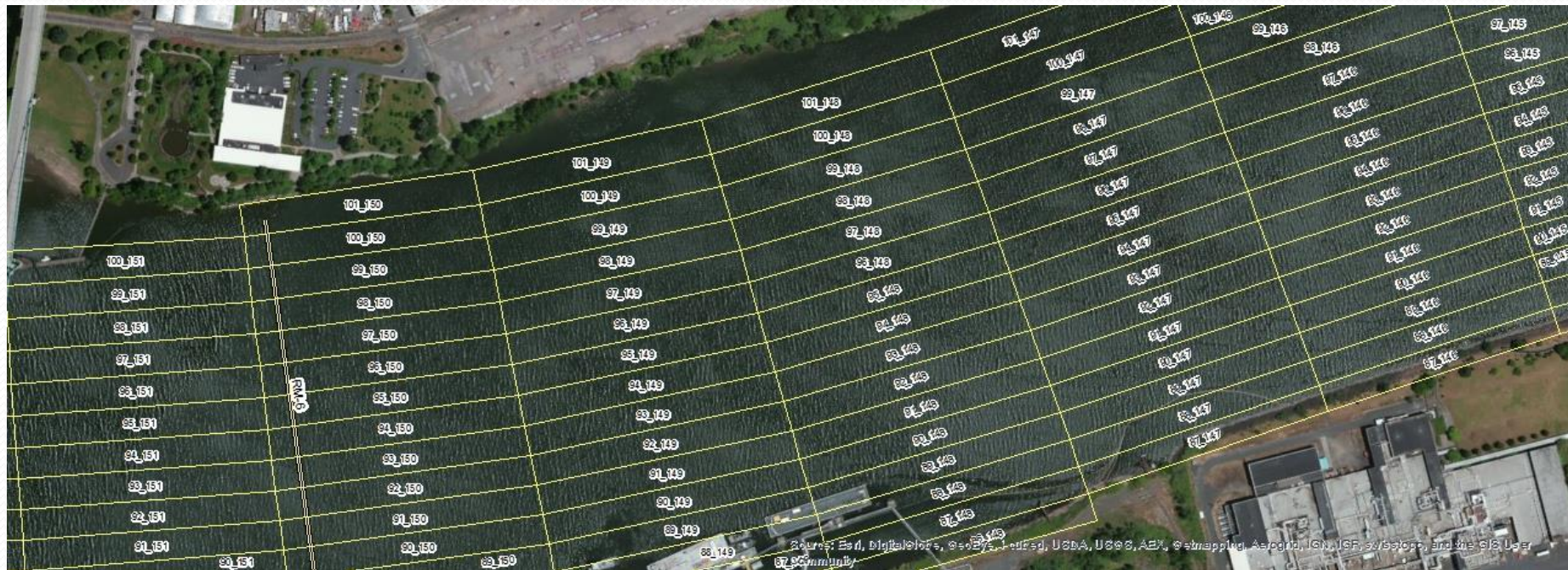
# Portland Harbor

## Modeling MNR

# LWG hydrodynamic and sediment transport (HST) model

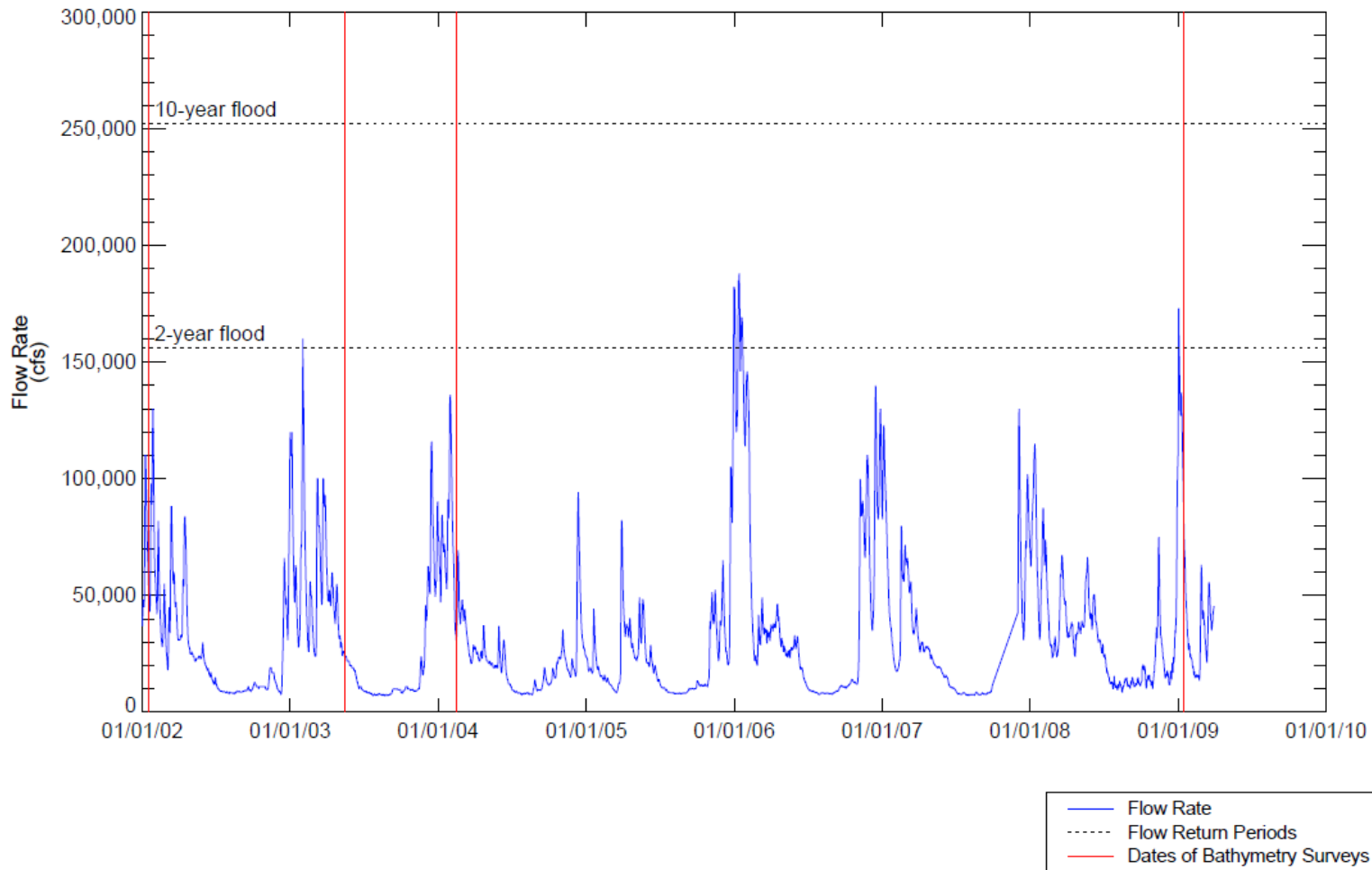
- Submitted in draft FS (2012)
- Used channel flow (EFDC) and channel sediment transport (SEDZLJ)
- Rejected by EPA
  - Models not coupled
  - Calibration was only for bathymetry, not chemistry
  - Complex system
    - Tidal fluctuations
    - Reverse flows
  - Did not account for bedload transport
  - Does not match CSM

# Model Grid Cells Example



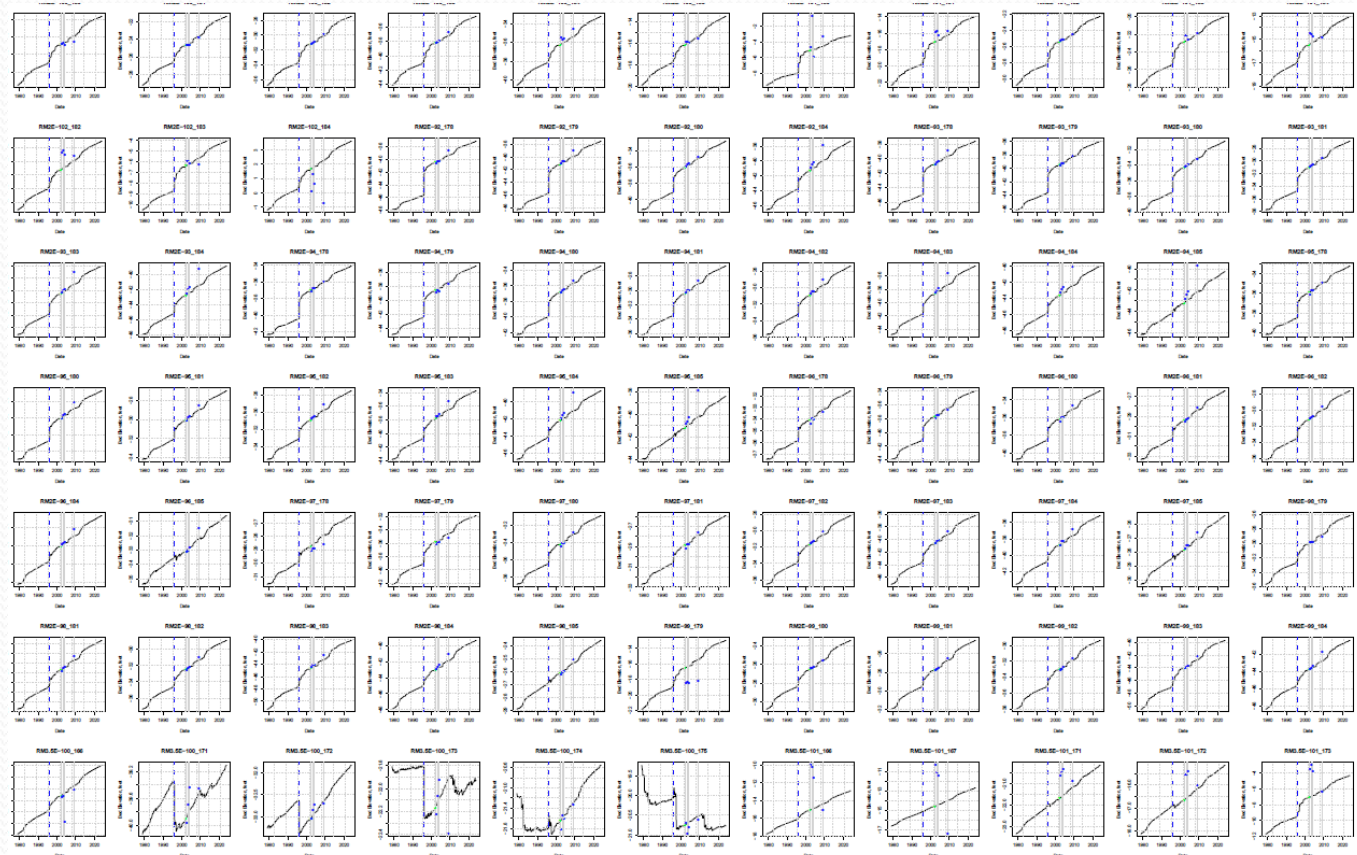


# Bathymetric Surveys



# t>0 discussion

- LWG Model performance vs. Bathymetry graphs



# Example of LWG Model Prediction

This figure, and those like it, show sediment concentrations over time projected for each remedial alternative. The upper panel shows the model best estimate or "base case", and the lower panel shows the most conservative (high concentration) "lower bound" estimate within the model calibration.

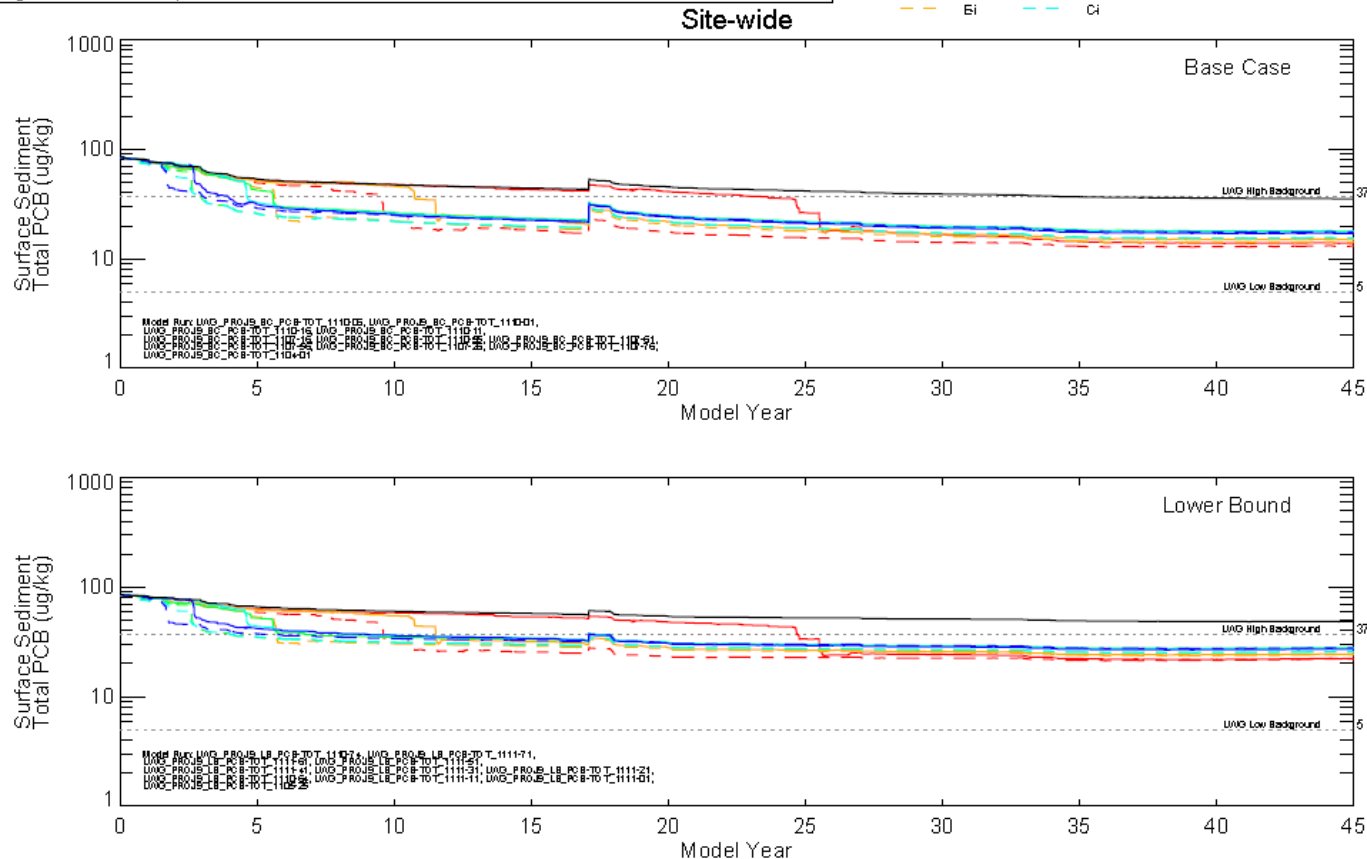


Figure 8.2.2-1

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OEA 

**LWG**  
LOWER WILLAMETTE GROUP

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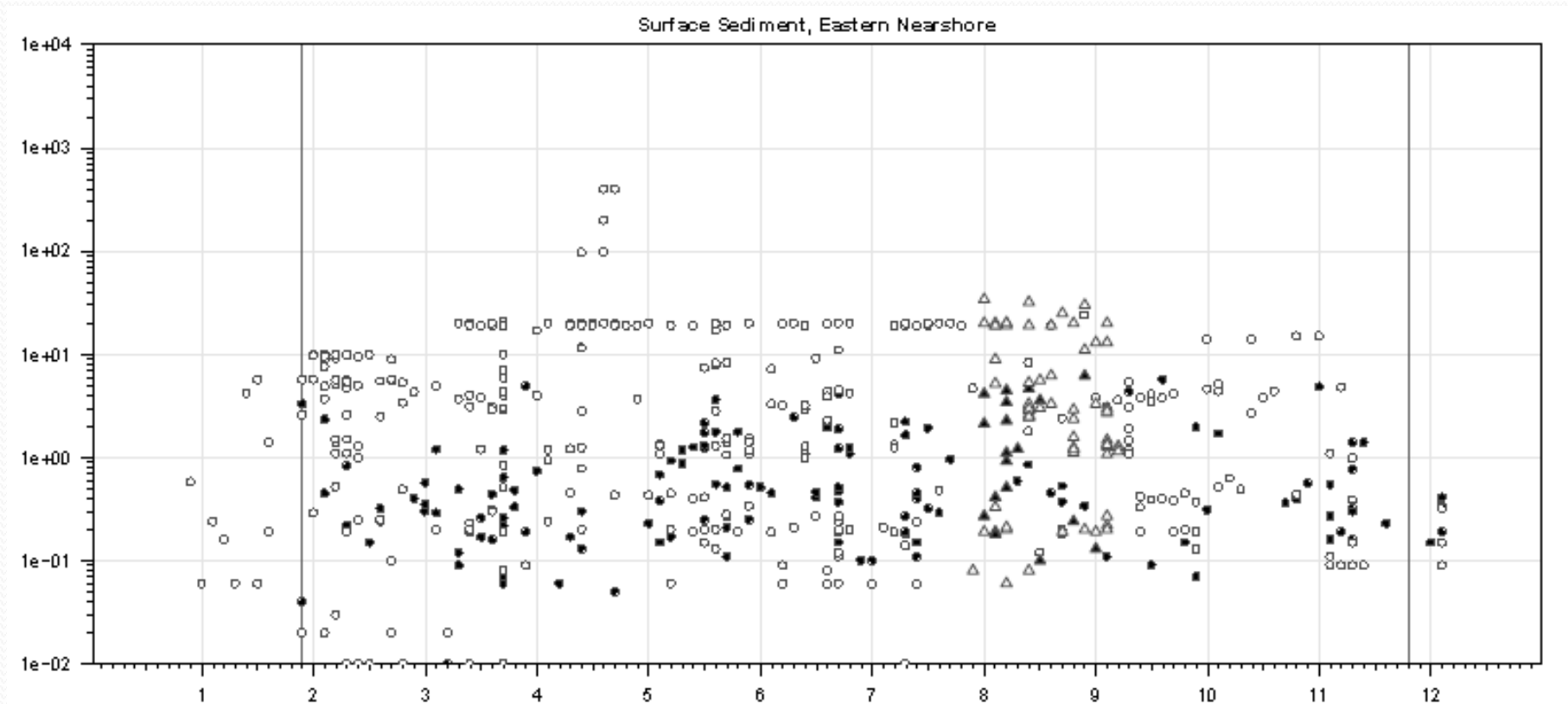
Time Series of Surface Sediment (Top 1-ft) Total PCB Concentrations (Site-wide Average)

**Portland Harbor RI/FS**  
Draft Feasibility Study  
Simulation of FS Alternatives

# Portland Harbor

High-biasing Non-detects  
in Data Set

# Example of High-biasing ND Hexachlorobenzene





# EPA Contacts

Kristine Koch – Lead RPM

- (206) 553-6705
- [koch.kristine@epa.gov](mailto:koch.kristine@epa.gov)

- Additional Information

<http://www.epa.gov/region10/portlandharbor>